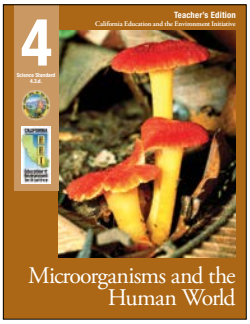
California Education and the Environment Initiative
Increasing Environmental Literacy for K–12 Students…
Because the Future is in Their Hands

TEACH COMMON CORE STANDARDS
WITH THE EEI CURRICULUM

Created with your needs in mind, this document shows the correlation between the EEI Curriculum and the California Common Core State Standards. By teaching the EEI unit lessons in your classroom, you will be simultaneously addressing the Common Core standards depicted in this guide.

4.3.d.—Microorganisms and the Human World



In this unit, students learn about beneficial and harmful microorganisms. Students examine how microorganisms are involved in many natural system processes that are used by humans and human communities. These processes are referred to as ecosystem services (for example, fermentation and decomposition). Students learn about these ecosystem services through research, investigations, and experiments. Students also recognize that microorganisms can cause changes to living things that may be harmful. This unit concludes with students utilizing the knowledge they have gained about microorganisms to create a poster about a microorganism of their choice that is helpful to humans; the poster consists of words and pictures to depict its role in natural processes, the ecosystem services it provides, and how it is beneficial to humans.

LESSONS	RI.4.1	RI.4.3	RI.4.4	RI.4.5	RI.4.6	RI.4.7	RI.4.10	RF.4.4	W.4.1	W.4.2	W.4.3	W.4.4	W.4.7	W.4.8	W.4.9	SL.4.1	SL.4.2	SL.4.4	L.4.4
California Connections	✓	✓	✓				✓												✓
1	✓		✓				✓		✓					✓					✓
2			✓			✓		✓						✓		✓	✓		✓
3			✓		✓					✓		✓	✓	✓	✓		✓		✓
4	✓	✓	✓	✓												✓	✓		✓
5	✓		✓		✓					✓			✓	✓			✓	✓	✓
6			✓			✓		✓			✓			✓					✓
Traditional Assessment										✓									
Alternative Assessment										✓								✓	

COMMON CORE STANDARDS

Note: *For your reference, the list of California Common Core State Standards abbreviations is on the following page.*

Using the EEI-Common Core Correlation Matrix

The matrix on the front page identifies a number of Common Core standards that are supported by this EEI unit. However, the check marks in the matrix do not necessarily signify that the Common Core standards checked will be taught to mastery by using this EEI unit alone. Teachers are encouraged to select which Common Core standards they wish to emphasize, rather than teaching to every indicated standard. By spending more time on selected standards, students will move toward greater Common Core proficiency in comprehension, critical thinking and making reasoned arguments from evidence. Teaching this EEI unit will provide opportunities for teachers to implement the shift in instructional practice necessary for full Common Core implementation.

California Common Core State Standards Abbreviations

- **CCCSS:** California Common Core State Standards
- **L:** Language Standards
- **RF:** Reading Foundational Skills Standars
- **RI:** Reading Standards for Informational Text
- **SL:** Speaking and Listening Standards
- **W:** Writing Standards

Note: *Since each Common Core standard includes a breadth of skills, in this correlation, the portion of the standard description that is featured in the Common Core Standards and Applications is cited, using "…" to indicate omitted phrases. For a list of the complete standard descriptions, please see the Common Core Reference Pages located on pages 21–22 of this document.*

A Note about Common Core Speaking and Listening Standards

Many of the EEI units provide various learning structures, materials, and groupings that lead toward students working in pairs or small groups to discuss concepts and ideas. This supports the skill in Speaking and Listening Standard 1 "Participate effectively in a range of collaborative discussions (one-on-one, groups…) with diverse partners." With prior instruction in collaborative discussion techniques, students can be placed in pairs or small groups to discuss the lesson topics. To aid in teacher planning, the lessons are listed below along with their learning structures for whole class, pairs/partners, and/or small groups:

- **Lesson 1:** Whole class, groups of 3 or 4
- **Lesson 2:** Whole class, groups of 4
- **Lesson 3:** Whole Class, partners (optional), groups of 4
- **Lesson 4:** Whole Class, partners (optional), groups of 4
- **Lesson 5:** Whole Class, partners (optional), groups of 4
- **Lesson 6:** Whole Class

National Geographic Resources

No maps or posters are used with this unit.

Unit Assessment Options

Assessments	Common Core Standards and Applications
Traditional Assessment	
Students answer multiple choice, fill-in-the-blank, and short answer questions.	**W.4.2b:** Develop the topic with facts, definitions, concrete details…or other information and examples…
Alternative Assessment	
Students create a poster about a microorganism that is helpful to humans. Using words and pictures, the posters describe and identify the microorganism, its role in natural processes, and the ecosystem services that it provides. A scoring rubric is provided.	**SL.4.4:** Report on a topic…using appropriate facts… **W.4.2d:** Use precise language and…vocabulary to inform about or explain the topic.

Lesson 1: Microorganisms Are Everywhere!

Students discuss their ideas about microorganisms. They examine cards showing different types of microorganisms—bacteria, protists, and fungi—and use clues to identify them. They read an article about San Francisco sourdough bread to learn that microorganisms can be helpful.


Lesson 1

Microorganisms Are Everywhere!

This lesson introduces students to the variety of microorganisms found in the world through both visual and written materials. The lesson begins with a class discussion of microorganisms to assess what students may already know about them, including whether or not they are beneficial to humans.

Use this correlation in place of the **Procedures** on pages 34–35 of the Teacher's Edition.

Procedures	Common Core Standards and Applications
Vocabulary Development	
Use the **Dictionary** and the vocabulary **Word Wall Cards** to introduce new words to students as appropriate. These documents are provided separately. ***Tip:*** *If* ***Dictionary Workbooks*** *need to be reused from year to year, students should not write in them.*	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **RI.4.4:** Determine the meaning of general academic and domain-specific words or phrases in a text…
Step 1	
Distribute a **Student Workbook** to each student. Tell them to turn to **What are Microorganisms?** (Student Workbook, page 2). Explain to students that they will answer a few questions to find out what they know about microorganisms, and they will answer the same questions at the end of the unit to see what they have learned. Give the class a few minutes to respond individually to the questions. "What are microorganisms? Where are they found in our world? How can microorganisms affect people?" Encourage students to be as thorough as possible in their responses. ***Tip:*** *If* ***Student Workbooks*** *need to be reused from year to year, students should not write in them. Some strategies teachers use to preserve the workbooks are:* ■ *Have students use binder paper or other lined or unlined paper* ■ *Have students use a sheet protector over the page and write with a whiteboard marker* ■ *Do together as a class on a projector or chart paper* ■ *Project the digital fill-in version and do together as a class* ■ *Students use digital devices to fill in the digital version found on the website.* ■ *Make student copies when necessary*	**W.4.8:** Recall relevant information from experiences…
Step 2	
Organize students into groups of three or four. Review the definition for organism" using the **Word Wall Cards**.	**W.4.1b:** Provide reasons that are supported by facts and details. **W.4.8:** …gather relevant information…and categorize information…

Procedures	Common Core Standards and Applications
Step 2 (Continued):	
Ask students, "What do you think a "micro" organism is? (*A tiny organism*) Explain that microorganisms are found almost everywhere on Earth: in the air, in the water, in the soil, and on plants and animals. Tell students that there are more bacteria than any other kind of microorganism. Distribute a **Student Edition** to each student. Tell them to turn to **Microorganism Background Information** (Student Edition, page 2). Briefly read the characteristics of each group of microorganisms with the students. Distribute a set of **Microorganisms** (Information Cards #1–9) to each group. Have students use **Microorganism Background Information** to sort the information cards into three groups: bacteria, fungi, and protists. Tell students some microorganisms look like they might belong in more than one category, but to make their best choice and to be prepared to explain the reason for their choice. Give students about ten minutes to sort the information cards.	**W.4.1b:** Provide reasons that are supported by facts and details. **W.4.8:** …gather relevant information…and categorize information…
Step 3	
Project **Bacteria, Fungi,** and **Protists** (Visual Aids #1–3) and identify each type of microorganism. Tell groups to correct the placement of the microorganisms in each group. Have students describe which characteristics led them to sort their **Microorganisms** information cards this way. Explain to students that microbiologists often use more information than they had here to identify microorganisms, which makes their work fun and interesting.	n/a
Step 4	
Tell students to turn to ***California Connections: San Francisco Sourdough*** (Student Edition, pages 3–7). Read the article as a class. After reading, discuss the microorganisms described in the reading using the following questions: ■ How are microorganisms used by people in the article? (*To make sourdough bread.*) ■ Which microorganisms are used? (*Yeast, bacteria*) ■ Where do the yeast and bacteria come from that are used to make sourdough bread? (*From packages of yeast or wild yeast from the air.*) ■ What do the yeast and bacteria do for the bread? (*They cause it to rise, making it light; they give it a sour taste; and they help it last longer.*) ■ Are these microorganisms helpful or harmful? Why? (*They are helpful because they help to make sourdough bread.*) Tell students that, over the next few lessons, they will learn more about microorganisms and how all living things rely on them for survival . Gather **Student Editions** and information cards. Collect **Student Workbooks** and use **What are Microorganisms?** for assessment.	**L.4.4a:** Use context…as a clue to the meaning of a word or phrase. ***Suggestion:*** *In the text, have students identify the surrounding context that helps them determine the meaning of words or phrases such as: symbiotic relationship, colony, starch.* **RI.4.1:** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences… ***Suggestion:*** *When answering questions, have students identify the text that supports their answers.* **RI.4.10:** …read and comprehend informational texts, including…science…text …proficiently, with scaffolding as needed… ***Suggestion:*** *Ask some of the scaffolding questions during the reading rather than all at the end. Have students reread the* ***California Connections*** *selection with partners.*

Lesson 2: Bacteria in Our Bodies

Students observe moldy bread and discuss the role of microorganisms in the decomposition process. They view a visual aid of the digestive system as they discuss the process of digestion and the bacteria in the large intestine that help to break down food.


Lesson 2

Bacteria in Our Bodies

Learning Objectives

Background

Use this correlation in place of the **Procedures** on pages 54–55 of the Teacher's Edition.

Procedures	Common Core Standards and Applications
Vocabulary Development	
Use the **Dictionary** and the vocabulary **Word Wall Cards** to introduce new words to students as appropriate.	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **RI.4.4:** Determine the meaning of general academic and domain-specific words or phrases in a text…
Step 1	
Remind students that in Lesson 1 that they learned about different types of microorganisms. Explain that in this lesson they will look more closely at two types of microorganisms: fungus and bacteria. (*Note: If necessary, review the definitions of these terms from the **Word Wall Cards**.*) Divide students into groups of four. Give each group one sample of moldy bread in a bag (Bag #1), one sample of fresh bread in a bag (Bag #2), four magnifying lenses, and a set of crayons or colored pencils. (*Note: If any student has mold allergies, project **Moldy Foods 1 and 2** [Visual Aids #4–5] instead of conducting the "Bread Lab." If this is the case, skip to Step 3.*)	n/a
Step 2	
Redistribute students' individual **Student Workbooks**. Tell them to turn to **Moldy Bread Observations** (Student Workbook, page 3). Remind students that mold is a type of fungus. Instruct the students to observe the bread in the bags with the magnifying lenses and make a sketch of their observations on **Moldy Bread Observations.** (*Note: An Answer Key and Sample Answers for **Moldy Bread Observations** are provided on page 60.*) Tell students not to remove the bread from the plastic bags while they do so. Discuss with the students what they think is happening in the bags with the moldy bread. (*Note: If using **Moldy Foods 1 and 2**, ask students what they think is happening to the food in the projected images.*) Review the term "decomposition" using the **Word Wall Cards**.	**RI.4.7:** Interpret information presented visually…and explain… ***Suggestion:** Encourage students to use the word "decomposition" in their **Student Workbook** when answering the observation questions.* **SL.4.1:** Engage effectively in…collaborative discussions… on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly. ***Suggestion:** Encourage the use of the term "decomposition" when participating in the discussion.*

Procedures	Common Core Standards and Applications
Step 3	
Ask students the following questions, and have them share their ideas: ■ What would the world look like if there were no decomposers? (*Answers should include that the land would be covered with dead plants and animals.*) ■ If we leave this bread in the bags for the next month, what will probably happen to it? (*It will continue to get moldy and start to disappear.*) (*Note: If using **Moldy Foods 1 and 2**, modify the question.*)	**SL.4.1d:** Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
Step 4	
Ask students the following questions to continue the discussion of decomposers: ■ Do you know that you have decomposers living in your body? (*Yes*) ■ What do you think they do there? (*Some make us sick and others help in digestion.*) ■ In which system of the body do they think that decomposers can be found? (*The digestive system*) Tell students that these microorganisms help them digest the food they eat. Project **Bacteria Within the Digestive Tract** (Visual Aid #6). Tell students that the drawing shows a human digestive system. Point to the large intestine and explain that it is part of the digestive system in their bodies. Tell them that it is located behind the belly button. Explain that there are beneficial (helpful) bacteria in the large intestine. They help us by breaking down food so that our bodies can get the nutrients that we need to stay strong and healthy. Point out that these bacteria stay in the large intestine, in the right amount. Ask students: ■ What would happen if these bacteria got into other parts of the body? (*They might make us sick.*) ■ How are these bacteria helpful to you? (*These microorganisms break down the food we eat into simpler, smaller parts. This helps release the nutrients, energy, minerals, and vitamins that our bodies need to live and grow.*)	**SL.4.1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly. a) Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b) Follow agreed-upon rules for discussions and carry out assigned roles. c) Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d) Review the key ideas expressed and explain their own ideas and understanding in light of the discussion. ***Suggestion:*** *Present questions on the board and allow for groups to discuss each question before whole class discussion.*
Step 5	
Point out the large intestine on **Bacteria Within the Digestive Tract.** Have the students guess how many microorganisms live in their large intestine. (*Predictions will vary.*) Tell the students that a healthy human body has over 750 trillion bacteria and other microorganisms in it, most of which are found in the large intestine. Challenge a student to come to the board and write this number. (*750,000,000,000,000*)	n/a

Procedures	Common Core Standards and Applications
Step 6	
Explain to students that the bacteria in their large intestines do three helpful things for them. Call students' attention to the **Bacteria Facts** written on the board. Read over each fact with the class. ■ Bacteria break down certain foods. This makes it easier for the human body to digest the foods. Once the food is digested, our bodies can use the energy from the food. ■ When bacteria break down foods, they release nutrients including vitamins, for example, vitamin C. ■ Some bacteria stop other, harmful organisms from living in the large intestine. Have students volunteer to read aloud each fact. Review each fact with students.	**RF.4.4:** Read with sufficient accuracy and fluency to support comprehension. **SL.4.2:** Paraphrase…information presented…orally. ***Suggestion:*** *Have students retell each fact in their own words.*
Step 7	
Tell students to turn to **Microorganisms and the Human Body** (Student Workbook, page 4). Give students the remaining class time to complete the task or assign it as homework. Gather the **Bread Lab** materials and dispose of the moldy bread without opening the bags. Collect **Student Workbooks** and use **Microorganisms and the Human Body** for assessment.	**W.4.8:** Recall relevant information from experiences or gather relevant information from print…

Lesson 3: The Battle with Bacteria

Students observe photographs of bacteria that can cause harm to their bodies, and discuss how infection occurs. A hand-washing demonstration shows students how to help reduce their exposure to harmful microorganisms.


Lesson 3

The Battle with Bacteria

This lesson continues the focus on bacteria living within our bodies. After learning in the previous lesson that bacteria in their large intestines are an important component of their bodies' digestive systems, students now learn that some microorganisms that enter our bodies can have harmful effects.

Use this correlation in place of the **Procedures** on pages 66–67 of the Teacher's Edition.

Procedures	Common Core Standards and Applications
Vocabulary Development	
Use the **Dictionary** and the vocabulary **Word Wall Cards** to introduce new words to students as appropriate.	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **RI.4.4:** Determine the meaning of general academic and domain-specific words or phrases in a text…
Step 1	
Ask students to share what they remember about helpful microorganisms in their bodies from the last lesson. (*Answers should include: the human body has over 750 trillion bacteria and other microorganisms in it, most of which are found in the large intestine; and, the bacteria in the large intestine help break down food, helping us use the nutrients and vitamins in the food.*)	n/a
Step 2	
Project ***Eschericha coli (E. coli)*** (Visual Aid #7). Point out that *E. coli* is one example of the bacteria living in the large intestine. Tell students that *E. coli* in the large intestine helps digest food, but if *E. coli* gets into other parts of our bodies, it can make us sick. *E. coli* can even damage our kidneys. When *E. coli* invade other parts of your body, you can get a harmful infection.	n/a
Step 3	
Project ***Salmonella*** (Visual Aid #8). Tell students that *Salmonella* is a bacteria that also lives in the intestines, but only a few are in a healthy person at one time. If too many *Salmonella* are in the intestines, or if they get into another part of your body, you can get a harmful infection.	**RI.4.6:** Compare and contrast…; describe the differences in focus and the information provided. ***Suggestion:*** *Use* ***Visual Aids #8 and #9*** *to have students compare and contrast the physical characteristics of the two microorganisms and the oral descriptions given.*
Step 4	
Write *"E. coli"* and *"Salmonella"* on the board. (*If students should ask,* Salmonella *is not named after the fish; it is named after the scientists who discovered it, Dr. Daniel Salmon.*) Ask students, "How can *E. coli* and *Salmonella* get into other parts of our bodies?" (*Answers may include touching something that has bacteria on it, eating something that has the bacteria in it, or drinking water that has the bacteria in it.*)	**W.4.8:** Recall relevant information from experiences…

Procedures	Common Core Standards and Applications
Step 5	
Review the term "contaminate" using the **Word Wall Cards**. Explain to the class that *E. coli* can get into our body through contaminated food, or if we swim in or drink contaminated water. Write each of these ideas under *"E. coli"* on the board. Also, explain that cuts and abrasions are ways that bacteria can enter the body. Tell students that *Salmonella* can also get into our bodies from contaminated food, for example, under-cooked chicken and raw eggs. Mention that you can also get it by touching birds, and reptiles, such as turtles, lizards, and snakes because these animals usually carry that bacteria on their skin. Explain that these animals can carry *Salmonella* and not be sick themselves. Mention that it is unlikely that you would get *Salmonella* by drinking or swimming in contaminated water. Write these ideas under *"Salmonella"* on the board.	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **SL.4.2:** Paraphrase portions of…information presented…visually…and orally. ***Suggestion:*** *Have partners take turns retelling each other the ways that E. coli and Salmonella can enter the body, using the ideas written on the board.*
Step 6	
Tell students to look at the lists on the board, and think about what they could do to keep themselves from becoming ill from an infection of *E. coli* or *Salmonella*. Have them share their ideas as a class. (*Responses may include washing hands, washing food before eating it, washing dishes thoroughly, drinking clean water, and swimming and bathing in clean water.*) Tell students that, because bacteria are living things, high temperatures can kill them. Thoroughly cooking food before eating it can kill *E. coli* and *Salmonella*, making the food safe to eat. Ask students, "Would heating water also kill *E. coli?*" (*Yes, boiling water will kill the bacteria, making it safe to drink and swim in. Chlorine can also kill these bacteria which is why it is put into swimming pools*.)	n/a
Step 7	
Organize students into groups of four. Tell the students that they are going to see how properly washing their hands can help prevent infection from *E. coli* and *Salmonella*. Redistribute students' individual **Student Workbooks**. Tell them to turn to **Hand Washing Experiment** (Student Workbook, page 5). (*Note: Make sure that students do not have a sensitivity to cinnamon.*) Have one student be the note-taker in each group. Explain that a person's hands will not be used in the demonstration. Remind students that bacteria cannot be seen without a microscope and explain to the class you will be using cinnamon as imaginary bacteria in this demonstration. Apply cooking spray to the front and back of each of the students' hands. Then, lightly sprinkle cinnamon on the palms and backs of their hands and between each student's fingers. Tell the class that the cinnamon represents *E. coli* or *Salmonella* that might get onto their hands. Have students "remind" you how that could happen. (*For Salmonella, touching contaminated reptiles or birds; for E. coli, drinking or touching contaminated water; or for both, eating or touching contaminated food.*)	n/a

Procedures	Common Core Standards and Applications
Step 8	
Have one student from each group come up to wash off the "bacteria" (cinnamon) using only cold water from the cold-water bucket. Tell them not to wipe their hands with paper towels, but to show their hands to the class. Have each group record their results on **Hand Washing Experiment.** (*The cinnamon did not come off their hands well using only cold water.*) Have another group member try to get rid of the "bacteria" by washing their hands using soap and cold water. Place a small bit of dishwashing soap in their palms, and ask them to wash in the cold water. Tell them not to wipe their hands with paper towels, but to show their hands to the class. Have the recorder in each group note their results on **Hand Washing Experiment.** (*The cinnamon did not completely come off their hands using soap and cold water, but more came off than did with just cold water.*) Have another group member try to get rid of the "bacteria" by washing their hands using soap and warm water. Place a small bit of soap in their palms, and ask them to wash in the warm water. Tell them not to wipe their hands with paper towels, but to show their hands to the class. Have each group record their results on **Hand Washing Experiment.** Tell the groups to work together to write a conclusion about the method that was most effective in getting the "bacteria" off the hands. (*The cinnamon rinsed right off the students' hands with the soap and warm water.*) If the students' hands still show signs of the cinnamon, have them return to the hand-washing area and clean their hands completely. Give the students' paper towels for drying their hands, and have them return to their seats. Ask students "What was the purpose of this Hand-Washing demonstration?" (*To learn that we cannot see bacteria on our hands; and that just wiping them off or using just water will not get rid of bacteria and prevent bacterial infection.)*	**W.4.2:** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. d) Use precise language and domain-specific vocabulary to inform about or explain… e) Provide a concluding statement…related to the information or explanation presented. **W.4.4:** Produce clear and coherent writing…appropriate to task… ***Suggestion:*** *Have all members of the group contribute to filling out the* ***Student Workbook*** *by describing what they notice so the recorder can take precise notes.* **W.4.7:** Conduct short research projects that build knowledge through investigations… **W.4.8:** Recall relevant information from experiences…and…take notes… **W.4.9:** Draw evidence…to support…reflection… ***Suggestion:*** *Have students write a reflection about what they learned from the experiment.*
Step 9	
Tell students to turn to **Why Maya Got Sick** (Student Workbook, page 6). Read the instructions with the class and have students complete the assignment as homework. Collect **Student Workbooks** and use **Why Maya Got Sick** for assessment.	**W.4.2b:** Develop the topic with facts…concrete details…or other information and examples related to the topic.

Lesson 4: Food from Microorganisms

Students observe sourdough bread and consider how its characteristics result from fermentation. They learn about the fermentation process as they watch yeast grow, and they play a guessing game to identify other popular foods created through fermentation.


Lesson 4

Food from Microorganisms

Learning Objectives

Background

Key Vocabulary

Use this correlation in place of the **Procedures** on pages 78–79 of the Teacher's Edition.

Procedures	Common Core Standards and Applications
Vocabulary Development	
Use the **Dictionary** and the vocabulary **Word Wall Cards** to introduce new words to students as appropriate.	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **RI.4.4:** Determine the meaning of general academic and domain-specific words or phrases in a text…
Step 1	
Ask students to recall the story they read about bread in the first lesson, ***California Connections: San Francisco Sourdough***. If necessary, redistribute the **Student Edition** and have the students read the story again. Ask students, "What kind of bread is San Francisco famous for?" (*Sourdough*) Tell the students that you are going to give each of them a piece of sourdough bread to examine. Advise students not to eat the bread. Distribute the bread, and instruct students to observe how it looks, feels, and smells. Ask students, "What words describe the bread?" (*Answers might include: tan, rough, smooth, soft, squishy, sour, lemony, has holes, has a hard crust.*) Collect and discard the bread slices from the students. Ask students if they remember where the holes in the slices of the bread come from. (A *process called fermentation*) Review the term "fermentation" and tell students that today they will observe the process of fermentation.	**RI.4.1:** Refer to details and examples in a text… **RI.4.3:** Explain…ideas…in a…scientific…text…including what happened and why, based on specific information in the text. **RI.4.4:** Determine the meaning of…domain-specific words… ***Suggestion:*** *Have students refer back to the* ***California Connections*** *and locate the word "fermentation." Have a student describe how the context of the words around it helps to understand the meaning.*
Step 2	
Divide the students into groups of four. Distribute the **Yeast Observation Materials** to each group. Instruct one student in each group to pour the sugar from the cup into the bowl. Have another student in the group locate the spoon and stand near the bowl. Circulate to each group and pour ½ cup of warm water from the insulated bottle into the bowl with the sugar. Tell the student with the spoon to stir the water and sugar in the bowl gently until the sugar has dissolved. When the sugar is completely dissolved, have the student with the spoon return it to the tray of materials.	**SL.4.2:** Paraphrase…information presented…orally. ***Suggestion:*** *Have students paraphrase each instruction or step before the class performs it.*

Procedures	Common Core Standards and Applications
Step 3	
Instruct a third student in each group to locate the packet of yeast and hold it up. Ask the class, "What kind of organism is yeast?" (*A microorganism; fungi*) Tell the students holding the yeast to lower the packets but to continue to hold them. Tell students that yeast is responsible for the natural process of fermentation. Tell the fourth student in the group to locate the magnifying lenses and hold on to them until they are told to pass one out to each of their group members. Ask the class, "Why do you think we need magnifying lenses?" (*To see the yeast at work because they are small, microorganisms*.)	n/a
Step 4	
Tell the students holding the yeast packets to carefully open the packets, sprinkle the yeast over the top of the warm sugar water, and place the empty packet on the tray. Have the students holding the magnifying lenses pass out one to each group member. Instruct students to observe the bowl of yeast with their magnifying lenses. Ask students: "What do you see?" (*The mixture is bubbling*.) Explain that the yeast is decomposing the sugar and that a gas is being released as this happens. Tell students that this gas is the same gas that they exhale or breathe out. Ask students: ■ What is this gas? (*Carbon dioxide*) ■ What are the similarities between the bubbles in the bowl with the dissolving yeast and the bubbles in yeasted bread dough? (*Both bubbles are made from the yeast giving off the carbon dioxide gas*.) ■ What do you think is the connection between this gas and the holes in the sourdough bread? (*This gas makes the bubbles in the dough. The bubbles become holes when the bread is baked*.)	**SL.4.2:** Paraphrase…information presented…orally. ***Suggestion:*** *Have students paraphrase each instruction or step before the class performs it. With a partner, ask students to use the teacher's description to retell what is occurring.*
Step 5	
Tell the class that people have used the natural process of fermentation for thousands of years to make bread. Tell students that fermentation is also used to make other foods that have the same characteristics as the sourdough bread: holes, bubbles, and a sour taste. Microorganisms like yeast and some bacteria help in this process. Point out the term "ecosystem service" on the **Word Wall Cards** and review the definition to the class.	**RI.4.4:** Determine the meaning of general academic and domain-specific words or phrases…

Procedures	Common Core Standards and Applications
Step 6	
Project **Foods from Microorganisms** (Visual Aid #9) Redistribute students' individual **Student Workbooks**. Tell them to turn to **Clues: Foods from Microorganisms** (Student Workbook, page 7). Explain that microorganisms are used to make all of the food items shown. Have the students read the clues about how a microorganism is used to make each of the foods, discuss as a group which food matches the function served by the microorganism, and write the name of the food on their copy of **Clues: Foods from Microorganisms**. (*Note: An Answer Key and Sample Answers for **Clues: Foods from Microorganisms** are provided on page 83.*) After students have completed **Clues: Foods from Microorganisms**, read the clues again. Have students raise their hands to share their groups' answers aloud. If desired, keep a tally of the number of correct responses each group makes. Ask students, "Why is fermentation an important ecosystem service to humans?" (*It helps make food that people can eat or sell to make money.*)	**RI.4.1:** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. ***Suggestion:** When students share their answers to the whole class, have them identify what part of the clue helped to determine the kind of food that was being described.* **SL.4.1:** Engage effectively in a range of collaborative discussions…, building on others' ideas and expressing their own clearly. c) Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d) Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
Step 7	
Tell students to turn to **Microorganisms and the Foods We Eat** (Student Workbook, page 8). Give students the remaining class time to complete the task or have students complete it as homework. Gather the **Yeast Observation Materials** from each group. Collect **Student Workbooks** and use **Microorganisms and the Foods We Eat** for assessment.	**RI.4.3:** Explain events,…ideas, or concepts in a…scientific… text, including what happened and why, based on specific information in the text. **RI.4.5:** Describe the overall structure (e.g., chronology…) of events,…concepts, or information…

Lesson 5: Clean Up That Spill!

Students view images of oil spills and consider their influence on the environment. They simulate an oil spill and attempt to clean it up. They learn about bacteria that decompose crude oil and are used to clean up oil spills.

Use this correlation in place of the **Procedures** on pages 88–89 of the Teacher's Edition.

Procedures	Common Core Standards and Applications
Vocabulary Development	
Use the **Dictionary** and the vocabulary **Word Wall Cards** to introduce new words to students as appropriate.	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **RI.4.4:** Determine the meaning of general academic and domain-specific words or phrases in a text…
Step 1	
Remind students that during this unit they have learned about several different types microorganisms; some that are helpful and some can be harmful. They have also learned that microorganisms provide ecosystem services for humans. Use the following questions to prepare students to discuss another role that bacteria plays in providing an ecosystem service to benefit humans and human communities: ■ What microorganisms are important in making bread? (*Yeast, bacteria*) ■ What ecosystem service do bacteria and yeast provide to produce: cheeses, bread, pickles and cider? (*Fermentation*) ■ What ecosystem service do bacteria provide in our large intestines? (*Digestion; they help us digest our food and release nutrients.*)	**SL.4.2:** Paraphrase portions of a text…orally. **W.4.8:** Recall relevant information from experiences or gather relevant information…; take notes…
Step 2	
Ask students to raise their hands if they have heard of or have seen an "oil spill." Ask students the following questions: ■ Where have you seen one? (*Answers may include: at the beach, in the ocean, on the ground, in the street, on a driveway, in a garage.*) ■ Where does the oil in a spill come from? (*Cars, ships, oil wells, oil tanks, trains*) ■ What do you think causes oil spills? (*Answers may include: a ship containing oil hits something like another ship or rocks, an oil pipeline breaks or leaks, an oil well blows up, a car leaks.*)	n/a

Procedures	Common Core Standards and Applications
Step 3	
Hold up the unopened bottle of motor oil and the unopened bottle of vegetable oil. Ask students: ■ What is the same about the substances in both these bottles? (*They are both "oils."*) ■ What is different about them? (*One is used in cars and other vehicles; the other is used for cooking and eating. The motor oil may be darker and the vegetable oil may be a lighter color.*) Tell students (unless they have said this already) that both oils have something else in common—they both come from plants. The motor oil comes from plants and animals that died millions of years ago and were buried deep in the ground. Explain that the vegetable oil comes from plants or their seeds that may have been farmed just a few months ago. Remind students that while we can eat vegetable oil eating, the motor oil will make us sick. Ask students, "What do you think happens if these oils spill?" (*Answers may include: nothing; it makes things slippery; it may pollute water; animals may be covered in oil; beaches may be covered with oil.*) After students have shared their ideas, project **Effects of Oil Spills 1–5,** (Visual Aids #10–14) and review the photographs with the students. Tell students that the oil that they see in the photographs is crude oil, which is the substance that motor oil is made from. Ask students, "How will the oil spill affect the habitat and the plants and animals that live there?" *(It will harm the habitat and may kill some of the plants and animals that live there.)*	**RI.4.6:** Compare and contrast…; describe the differences in focus and the information provided. **SL.4.2:** Paraphrase portions of …information presented…orally. ***Suggestion:*** *Have students paraphrase information learned from the oral presentation and* ***Visual Aids #10–14*** *with their partner.*
Step 4	
Tell the class that both vegetable oil and motor oil can spill, but a crude oil spill is much more dangerous than a vegetable oil spill. Remind students that motor oil is made from crude oil. Explain that crude oil was formed from the remains of very small plants and animals that lived millions of years ago in ancient seas. Mention that when these organisms died they sank to the bottom of the sea and were covered with layers of mud. Point out that heat and pressure helped turn the remains of these organisms into crude oil. Explain that crude oil is sticky and difficult to remove. Tell students that animals and plants covered in crude oil may die if they cannot take it off themselves (if they eat it off their own fur or feathers they may become sick). Explain that if the places where the animals live are also covered in oil, it is even harder for them to get the oil off themselves. If their water is polluted with oil, they can become sick and die. Tell students that people can help clean up crude oil spills and have tried many different ways to take the oil off animals, beaches, and water.	**RI.4.7:** Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. ***Suggestion:*** *Have students research more information on how crude oil is formed to make sure they understand this idea.*

Procedures	Common Core Standards and Applications
Step 4 (Continued):	
Explain that students will work in groups to see how well certain materials can clean up oil spills. Tell them that because crude oil is hazardous, they will work with vegetable oil instead. Mention that the cleaning materials they will use are similar to those used to clean up crude oil spills.	**RI.4.7:** Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. ***Suggestion:*** *Have students research more information on how crude oil is formed to make sure they understand this idea.*
Step 5	
Divide the class into groups of four and give each group a set of **Oil Spill and Cleanup Materials**. Redistribute students' individual **Student Workbooks**. Tell them to turn to **Cleaning Up an Oil Spill** (Student Workbook, pages 9–10). Instruct the groups to follow the instructions and work together to complete the task. Circulate among the students to dispense cups of vegetable oil when it is time and to check that they are recording their results. (*Note: An Answer Key and Sample Answers for* ***Cleaning Up an Oil Spill*** *are provided on pages 97–98.*)	**RI.4.1:** Refer to details and examples in a text… **SL.4.2:** Paraphrase portions of a text… ***Suggestion:*** *Break up the investigation into parts and read through steps together, and then have students summarize in their groups what they are going to do.* **W.4.2:** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. d) Use precise language and domain-specific vocabulary to inform about or explain the topic. e) Provide a concluding statement or section related to the information or explanation presented. **W.4.7:** Conduct short research projects that build knowledge through investigation of different aspects of a topic. **W.4.8:** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, paraphrase, and categorize information, and provide a list of sources.
Step 6	
Once the groups have tested all of their materials, discuss their findings. Have each group share which material they thought cleaned the oil most effectively. Collect the sets of **Oil Spill and Cleanup Materials** from the groups. (*Note: Speak to the school custodian to find the safest place to dispose of these materials.*)	**SL.4.4:** Report on a topic or…recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.
Step 7	
Review with the class that crude oil is made from the remains of dead plants, algae, and animals. Ask students the following questions. ■ What do decomposers do to dead plants and animals? (*They break down—decompose—the matter.*) ■ Since some microorganisms are decomposers, and decomposers break down dead plants and animals, do you think that some microorganisms might be able to help clean up crude oil spills? (*Yes, if they can break down the oil.*)	**W.4.7:** Conduct short research projects that build knowledge through investigation of different aspects of a topic. ***Suggestion:*** *If students have access to computers, invite them to research a time when Cyanobacteria were used to clean-up an oil spill in real-life. Depending on the level of computer skills the students possess, it may be necessary to provide students with helpful websites.*

Procedures	Common Core Standards and Applications
Step 7 (Continued):	
Project ***Cyanobacteria*** (Visual Aid #15). Explain that *Cyanobacteria* are living things that live in watery environments and can survive in both freshwater and saltwater. Mention that *Cyanobacteria* use the sunlight to make their food through photosynthesis and can live in waters that are contaminated by oil. Explain that *Cyanobacteria* are special because they can clean up oils spills. Explain that *Cyanobacteria* require certain conditions, such as the correct nutrients, oxygen levels, and temperature, to clean up an oil spill. Point out that sometimes people add nutrients to the area where oil has spilled, providing food for the *Cyanobacteria*, thus giving them more energy to help break down the oil.	**W.4.7:** Conduct short research projects that build knowledge through investigation of different aspects of a topic. ***Suggestion:*** *If students have access to computers, invite them to research a time when Cyanobacteria were used to clean-up an oil spill in real-life. Depending on the level of computer skills the students possess, it may be necessary to provide students with helpful websites.*
Step 8	
Tell students to turn to **Microorganisms Quiz** (Student Workbook, page 11). Have them complete the quiz in class, or as homework. Collect **Student Workbooks** and use **Microorganisms Quiz** for assessment.	**W.4.2:** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. b) Develop the topic with facts, definitions, concrete details… or other information and examples related to the topic. d) Use precise language and domain-specific vocabulary to inform about or explain the topic.

Lesson 6: Microorganisms in Medicine

Students discuss their experiences with sickness and the medicine they took to get well. They read about the discovery of antibiotics and their importance to human health. They learn that antibiotic production by microorganisms is used to make important pharmaceuticals.


Lesson 6

Microorganisms in Medicine

This final lesson focuses again on the role of microorganisms in natural processes that provide ecosystem services. The lesson introduces students to the ecosystem service some microorganisms provide as they help produce the important pharmaceuticals used to treat infections.

Learning Objectives

Background

Key Vocabulary

Use this correlation in place of the **Procedures** on page 104 of the Teacher's Edition.

Procedures	Common Core Standards and Applications
Vocabulary Development	
Use the **Dictionary** and the vocabulary **Word Wall Cards** to introduce new words to students as appropriate.	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **RI.4.4:** Determine the meaning of general academic and domain-specific words or phrases in a text…
Step 1	
Ask students about their experiences with illness, medical treatment, and medication using the following questions: ■ Have you ever been sick enough that you had to go to the doctor? (*Answers will vary.*) ■ How did the doctor find out what was making you sick? (*Answers may include taking their temperature, examining them, taking blood or other samples to test.*) ■ Did the doctor give you any medicine to help you get better? (*Answers will vary.*)	n/a
Step 2	
Ask students to raise their hands if they remember taking antibiotics to get better. Write the word "antibiotic" on the board and cover up the "biotic" part of the word with one hand. Ask students to tell you what "anti" means (*Against*) Then, cover the "anti" part of the word, uncovering the "biotic" part of the word, and tell students that "biotic" means "life" or "living." Ask, "What do you think an antibiotic is?" (*Something that goes against life.*) Review the term "antibiotic." Explain that sometimes, as they learned in Lesson 3, bacteria can cause infections and make us get sick. Tell students that some antibiotics are medicines that can be used to kill the bacteria that are infecting us, helping us to get well.	**L.4.4:** Determine or clarify the meaning of unknown… words… b) Use common, grade-appropriate Greek and Latin affixes and roots as clues to the meaning of a word… c) Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation and determine or clarify the precise meaning of key words…

Procedures	Common Core Standards and Applications
Step 3	
Ask the class, "What do you think antibiotics are made out of?" (*Answers may include poison or other dangerous substances.*) Explain that at one time doctors gave poisons to people with infections, but the poison often caused harm to the patient. Tell the class that antibiotics are chemical compounds that can kill or slow down the growth of a specific bacteria without causing great harm to the body in which the bacteria is growing. Tell students that one of the most famous antibiotics is made by a fungus, one whose enemy is bacteria.	n/a
Step 4	
Distribute a **Student Edition** to each student. Tell them to turn to **History of Antibiotics** (Student Edition, pages 8–9). Call on students to help read the article aloud.	**RF.4.4:** Read with sufficient accuracy and fluency to support comprehension.
Step 5	
Project **Microorganism Battle** (Visual Aid #16). Point out the mold, the "antibiotic crust," and the bacteria to students. Emphasize that before antibiotics were discovered, many more people died or were disabled by diseases caused by bacteria.	**RI.4.7:** Interpret information presented visually…
Step 6	
Review the definition of "ecosystem service." Ask students to explain how microorganisms provide an ecosystem service by making antibiotics, like penicillin. (*Some molds make antibiotics to protect themselves from bacteria. The antibiotics they produce are used by humans to make medicines to treat bacterial infections.*)	**W.4.8:** Recall relevant information from experiences…; take notes [and] paraphrase…information…
Step 7	
Redistribute students' individual **Student Workbooks**. Tell them to turn to **Bacteria and Mold Battle it Out!** (Student Workbook, page 12). Review the instructions and give students time to complete the assignment. Gather **Student Editions**. Collect **Student Workbooks** and use **Bacteria and Mold Battle it Out!** for assessment.	**L.4.4c:** Consult reference materials…to…determine or clarify the precise meaning of key words and phrases… **RI.4.7:** Interpret information presented visually…(e.g., in… diagrams…) and explain how the information contributes to an understanding of the text in which it appears. **W.4.3:** Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

Unit Assessment

Refer to the introduction pages at the front of this document for information regarding the Traditional and Alternative Assessments for this unit and their Common Core correlations.

California Common Core State Standards Descriptions

Language Standards

- **L.4.4:** Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grade 4 reading and content,* choosing flexibly from a range of strategies.
  a) Use context (e.g., definitions, examples, or restatements in text) as a clue to the meaning of a word or phrase.
  b) Use common, grade-appropriate Greek and Latin affixes and roots as clues to the meaning of a word (e.g., *telegraph, photograph, autograph*).
  c) Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation and determine or clarify the precise meaning of key words and phrases **and to identify alternate word choices *in all content areas*. CA**

Reading Foundational Skills Standards

- **RF.4.4:** Read with sufficient accuracy and fluency to support comprehension.

Reading Standards for Informational Text

- **RI.4.1:** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- **RI.4.3:** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
- **RI.4.4** Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a *grade 4 topic or subject area*. **(See grade 4 Language standards 4–6 for additional expectations.) CA**
- **RI.4.5:** Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.
- **RI.4.6:** Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in focus and the information provided.
- **RI.4.7:** Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
- **RI.4.10:** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

Speaking and Listening Standards

- **SL.4.1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.
  a) Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
  b) Follow agreed-upon rules for discussions and carry out assigned roles.
  c) Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.
  d) Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
- **SL.4.2:** Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- **SL.4.4:** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Writing Standards

- **W.4.1:** Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
  - b) Provide reasons that are supported by facts and details.
- **W.4.2:** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
  - b) Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.
  - d) Use precise language and domain-specific vocabulary to inform about or explain the topic.
  - e) Provide a concluding statement or section related to the information or explanation presented.
- **W.4.3:** Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
- **W.4.4:** Produce clear and coherent writing **(including multiple-paragraph texts)** in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.) **CA**
- **W.4.7:** Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- **W.4.8:** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, paraphrase, and categorize information, and provide a list of sources.
- **W.4.9:** Draw evidence from literary or informational texts to support analysis, reflection, and research.